

LIGHTING DATA

EDISON LAMP WORKS
OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE

HARRISON, N. J.

Railway System Lighting Buildings and Yards



Information compiled by

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Lighting Service Department

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Railway System Lighting

*Information Compiled by J. H. Kurlander
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Introductory

It would be difficult to find another industry where the use of artificial light finds such broad and diverse application as in the operation and maintenance of railroads. This is due to the wide scope of activities and to the fact that operation in many departments is continuous throughout the entire 24 hours of the day.

Train lighting proper is covered in Bulletin Index 96 and this phase of the subject has had such attention devoted to it as to tend to make standard certain practices and also familiarize interested persons with them.

No attempt seems to have been made, however, to co-ordinate the work done along the lines indicated by the synopsis. Each problem has been solved separately as it arose, with the result that few, if any, installations covering the same field are similar in nature. An effort will be made to combine data on current practices obtained from some of the leading railroads in the east so as to present it in an orderly and logical manner. Instead of drawing lengthy word pictures of the various subjects, photographs of actual installations supplemented by diagrams have been resorted to, with the hope that the subject, as a whole, will be rendered clearer and more concise, thus making the information readily available. The suggestions contained herein are practical, and not theoretical, as nearly all of them have been extensively applied in actual service. Where more than one method is applicable to a certain problem, the other methods are also presented, so that the one best meeting local conditions may be adopted.

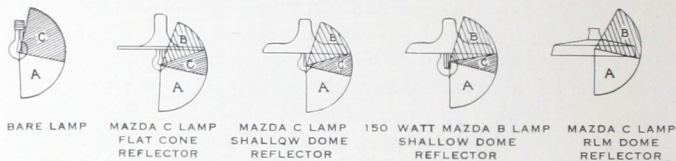
Modern Lighting Practice

There are three fundamental considerations of a successful lighting installation. These are:

- Intensity
- Quality
- Distribution

For conducting work of any nature, light, either artificial or natural, must be provided. For indoor work, either of these is somewhat costly to obtain. We ordinarily think of daylight as being free, but the windows placed in structures to secure it cost more than the same amount of wall space, and even then it is not always practicable to obtain daylight in all spaces. When night comes, reliance is placed

on artificial light for continuing our work. The proper amount provided by artificial means is often a debatable subject. We may argue at length as to whether two foot-candles are all that is needed to carry on work satisfactorily, or whether three foot-candles should be provided. Yet, during the day, the intensity of light received from the sun may vary from possibly one hundred foot-candles one minute to forty foot-candles the next, but either of these intensities is above that ordinarily provided by the artificial lighting system. Determinations should be based on practice but modified as conditions change, and the lighting art advances. It is easily demonstrable, within the range of any existing practice, that the more light provided, the greater the ease and rapidity with which work can be carried on. As we raise the intensity our seeing ability, or visual power increases also, until we reach a point where a further increase in intensity will



SHOWING LIGHT UTILIZATION WITH VARIOUS COMBINATIONS OF LAMPS AND REFLECTORS.

A=Direct light, largely useful.

B=Reflected light, largely useful.

C=Light tending to cause glare, least useful, largely wasted.

benefit our seeing ability but slightly. There is an economical limit above which the cost of raising the intensity would be out of proportion to the benefits derived; however, very few such cases have been noted, practically none under artificial illumination. The majority are well below the economical limit. Glare is sometimes confused with "over-lighting" and the rectification of so called "over-lighting" is obtained by reducing the apparent brilliancy of the illuminant and not by cutting down in the amount of light supplied. The benefits derived in the form of increased production from raising the intensity to that of so-called productive lighting, and increasing the efficiency of the process, would more than offset the expense of accomplishing this. The two primary benefits of a good lighting installation are greater production and safety. Increases of from ten to thirty-five per cent in the production of machine shops have been obtained by actual test where illumination has been raised from what is ordinarily

regarded as good practice to higher levels, with an operating cost of less than five per cent of the payroll expense. See Bulletin Index 17.

As we raise the standard of illumination, the second and third factors, quality and distribution, come more to the front. Quality means steady light of such a nature as to be comparatively free from glare and harshness, while desirable distribution means light from the proper direction spread evenly over the working area so as to produce economical and effective utilization. The ultimate aim of the lighting is to make it easy to see objects. For proper perspective, the distribution of light should be such as to give natural shading which is not present under light of too diffuse a nature. While diffusion of a medium degree is necessary and should be encouraged, still it should not be carried to the point of rendering an object flat in appearance.

In spite of the efficient light sources available today in the form of MAZDA C lamps, some light users still cling to the old type of

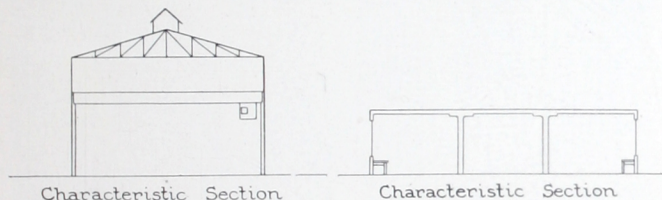


FIG. 2

Sketch Showing Typical Sections of Group "A" Shops and Group "B" Shops

MAZDA B lamp above 60 watts. One reason for using these older type lamps is that they have been in service for a number of years, and the policy in such cases is evidently to use them until they burn out. Another reason advanced is that the filaments of these lamps are not so glaring as those of the MAZDA C type. Neither is a valid excuse for their continued use. In the first case, the slight expense involved in the purchase of a modern lamp is more than offset by the saving in power consumed and betterment in quality of light. In the second case, high wattage lamps of any sort should not be used in such a manner that the unshielded filament is within range of the observer's vision. With modern reflectors and diffusing devices, the greater brilliancy of the more efficient lamp does not stand in the way of its adoption.

A necessary adjunct to any efficient lighting installation is a durable reflector of proper design. The first requirement is very easily

met, but some people do not understand what constitutes a proper design. In Fig. 1 are shown five sketches of possibilities in the way of lamp accessories. In the first place the reflector is conspicuous by its absence. This condition is a quite common one throughout industrial establishments and the sole reason for its existence seems to be that a reflector is sometimes looked upon as a liability and not an asset. The sketches illustrate quite clearly what happens when various combinations of reflectors and lamps are used. A more complete discussion of the properties of reflectors is given in Bulletin Index 22. Reflectors serve not merely to re-direct to the working plane, light which would otherwise be wasted, but also tend toward better lighting conditions by eliminating glare and protecting lamps from dust coatings and breakage.

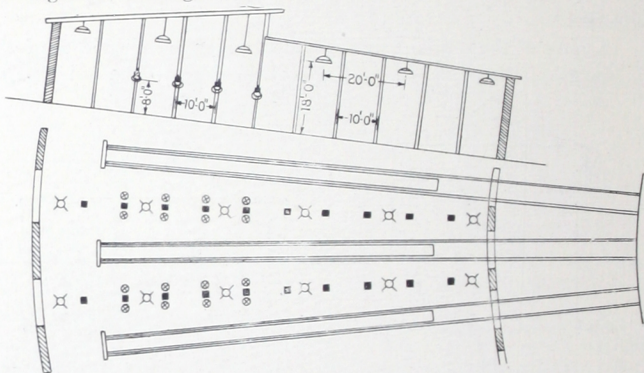


FIG. 3

PLAN OF ROUNDHOUSE SHOWING LOCATION OF OUTLETS

⊙=100 watt Mazda "C" lamp in elliptical angle reflector mounted on column 8'-0" above floor.

⊠=200 watt Mazda C lamp in R.L.M. dome reflector mounted 20'-0" above floor.

Recommendations

Shops

All the principal industrial parts of the railway system with the exception of the roundhouse can be grouped as follows:

Buildings having the characteristic section shown in Fig. 2 with high ceilings are placed in Group "A." These include erecting shops, foundries, car shops.

Those with low ceilings are included in Group "B," as follows: machine, tank, paint, wheel, forge, carpenter shop, etc.

Roundhouses

The lighting of this type of structure presents a rather difficult problem, inasmuch as the interior is commonly filled with dense clouds of smoke and gases. The smoke acts as a screen tending to prevent light from the units reaching the working plane and the acid and gases attack all exposed metal work of the lighting installation, thus making the cost of upkeep relatively high. The roundhouse serves as a stable for engines awaiting duty, and minor repairs on the engine are made here. A great deal of the work is performed at the head and sides of the engine and the best light is needed at these



FIG. 4

Night View of Roundhouse Lighted by the Combination of Overhead and Angle Units Discussed in the Text. Despite the fact that the building is well filled with smoke, the intensity is such as to facilitate rapid work on any part of the locomotive

points. Little or no work is done on the tender and, consequently, the passageways between stalls need only sufficient illumination to ensure safe walking conditions. One important repair effected at the roundhouse is that of the turbine generator set mounted directly in front of the smoke stack. If the overhead units are hung too low, this machine will be left in darkness which will necessitate using a local lamp or hand torch.

There are two general systems in vogue for lighting roundhouses. One makes use of floodlighting projectors mounted on the sidewalls and projecting light down the passageway between stalls toward the turntable. This method, while giving a good intensity upon the work, has the objection that it is glaring and the light is not diffused. It has a predominant direction, with the result that there are sharp shadows and a person with his back to the light would be likely to cast a shadow directly on the work. The light does not penetrate well into the mechanism at the side of the locomotive.

The other plan involves the use of high wattage lamps suitably placed in efficient reflectors and uniformly spaced down the passageways. In addition to this, angle reflector units are mounted on the columns approximately eight feet high, projecting the light horizontally on the engine's sides. Fig. 3 shows this arrangement in detail and Fig. 4 shows a night view taken of such an installation.

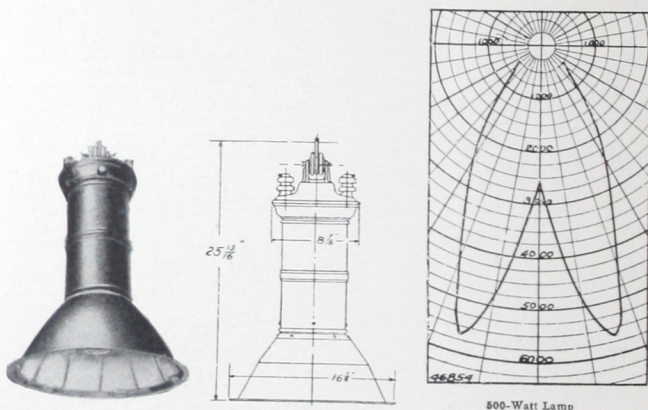
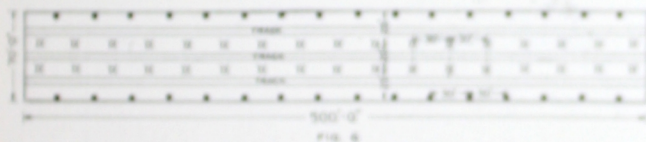


FIG. 5
Industrial Lighting Unit for High Hangings

The hydrogen sulphide gas emitted by locomotives combines with steam which, when deposited on exposed metal work, forms sulphuric acid. This results in rapid deterioration of the metal. For this reason, exposed conduits in roundhouses have but a short life, and, unless some means is taken to limit the scope of this action, the cost of maintenance will soon be out of proportion to that of the rest of the installation. One of the best methods for limiting the corrosion of conduit is to run the major portion of the circuit either on top

of the roundhouse roof or else embed it in the concrete roof where such construction is employed. If wiring is placed on the roof, it should be given a good coat of some suitable weather-proofing paint to prevent its being attacked by rain, snow or moisture. The vertical section of conduit used for supporting the lamp and reflector would necessarily have to be replaced when corrosion advanced to such a stage as to render this replacement necessary. These vertical sections of conduit can be threaded on one end which will allow of their being unscrewed from the main section, and a new section being installed. Another method is to run the feeders and branches approximately four or five feet below the roof of the roundhouse, in order to place them below the level of the gases accumulated under the roof. The conduits should also be given a good coat of paint. These methods of protecting wiring circuits have already found wide application.

Convenience outlets should be placed at frequent intervals on side-walls and columns in such a manner that portable extension lamps can be used with little danger of injury to workmen due to stumbling over such cords. For protecting the cord itself, it would be well to use some form of armored cable.



PLAN OF ERECTING SHOP SHOWING LOCATION OF UNITS
 H-500 watt Mazda C lamp in BLM dome reflector
 ★-500 watt Mazda C lamp in elliptical angle reflector

Group "A"—Shops

Erecting Shop

As shown in Fig. 2, the lamp locations in this shop are limited by the overhead cranes. The work is of a fairly coarse nature inasmuch as large metal parts are handled, assembled or taken apart and, except for occasional fittings, no very exacting demands as to lighting exist. Illumination on vertical surfaces must be as good as, if not better than, that on horizontal planes in many cases and light must penetrate in nooks and corners not often encountered even in machine shop work. There are some places where local lights, either of the portable incandescent lamp type, or a hand oil torch, must be used. Where work is being performed on the inside of the boiler, a local or portable lamp is indispensable. A fairly high intensity is desirable

in order to speed up work on the engine so as to enable it to leave the shop in first-class condition at the earliest possible moment.

When considering the type of installation for this class of structure, it will be easily seen that there are two general methods applicable, one makes use of high wattage overhead units in either deep bowl or RLM Dome reflectors; the other makes use of special industrial lighting units (Fig. 5). The use of the latter type is required only in places having exceedingly high ceilings or where the atmospheric conditions are such as to absorb a large percentage of the light from overhead units. The average erecting shop, however, can be



FIG. 7

Night View of Erecting Shop Lighted by Two Rows of 500-Watt MAZDA C Lamps in RLM Dome Reflectors Spaced on 20 by 30 Foot Centers Down the Center of the Shop and 500-Watt MAZDA C Lamps in Elliptical Angle Reflectors Spaced 30 Feet Apart Hung on Each Side Wall. Both types of units are hung approximately 30 feet high. Intensity provided is seven foot-candles. Good light on vertical surfaces.

lighted by two rows of either 500, 750 or 1000-watt units in RLM Dome reflectors running down the center of the shop and one row of elliptical angle reflectors containing 500-watt MAZDA C lamps mounted on each side wall (see Fig. 6) in order to give good illumination on vertical surfaces. Fig. 7 shows an erecting shop lighted by such an installation.

For small erecting shops with ceilings approximating those of the average factory room, a method which gives good results is to run a line of 300 or 300-watt Type C lamps in RLM Dome reflectors down each aisle between tracks, as illustrated in Fig. 8. Convenience outlets should be provided at frequent intervals.

Car Shops

The machine work performed in these shops, such as punch-pressing, trip-hammering, welding, general assembling, etc., does not require a great deal of light for its performance. The building used for this work is characterized by a width of from 50 to 80 feet, a great



FIG. 8

Night View of Erecting Shop Lighted by 400-Watt Mazda C Lamps in RLM Dome Reflectors Hung 17 1/2 Foot High and Spaced on 13 Foot Centers. This system is particularly applicable to shops having a low ceiling height. Intensity 14 foot-candles

length and high ceiling. Local lighting is unnecessary, save when working on car interiors and for this convenience outlets and well shielded portable lamps should be part of the equipment. General lighting should provide a medium intensity over the entire floor surface, preferably from high wattage MAZDA C lamps in deep bowl metal reflectors, supplemented by smaller lamps in angle reflectors, mounted on the sidewalls. The electric crane, always present in this

type of shop, makes necessary a high hanging, in the neighborhood of 30 feet. Fig. 9 shows a section view of a car shop and positions of units.

Foundries

In foundry work, one encounters conditions somewhat different than the other shops discussed. There is always present, more or less of a haze due to the presence of smoke which tends to absorb the light from the overhead units. Then again, good diffusion is necessary, as all parts of the mold should be distinctly visible for the purpose of effecting repairs to breaks or cracks in the mold. Where the light has

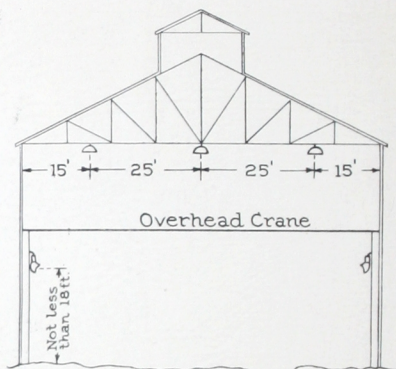


FIG. 9

SECTION OF STEEL CAR REPAIR SHOP SHOWING
LOCATION OF UNITS.

500 watt Mazda "C" lamps in deep bowl reflectors

200 watt Mazda "C" lamps in elliptical angle reflectors

a predominating direction, such as straight downward, shadows are apt to be cast by edges of the mold leaving the sides at the point involved in darkness, thus hiding a possible mar in the mold. In order to overcome this, a system similar to that employed in the erecting shop should be resorted to, using overhead high wattage MAZDA C lamps in dome reflectors and similar lamps in angle reflectors, mounted at the same height on the sidewalls. The cross rays of light will tend to break up any shadows caused by the overhead units. This system has been tried out and the results found very satisfying. More detailed data on this subject will be found in Bulletin Index 66, "The Lighting of Steel Mills and Foundries."

*Group "B"—Shops**Machine, Forge and Wheel Shops, etc.*

The shops grouped under this heading are contained in rooms approximating those of the average factory. The lighting of them, therefore, becomes a problem similar to that of the ordinary industrial plant. See Bulletin Index 62, "The Lighting of Machine Shops." There are few, if any, cases where a straight general system cannot be employed to good advantage. There may be times, however, when local lighting will be necessary, such as when painting the interior of cars and over certain machines found in the tin or metal shops.



FIG. 10

Machine Shop Lighted by 200-Watt MAZDA C Lamps in RLM Standard Dome Reflectors Spaced on 12 by 12 Foot Centers and Hung 14 Feet High. The distribution is excellent as can be noted from the soft shadows and the intensity is in the neighborhood of seven foot-candles

In the former case, the general custom seems to be to place a bare 75 or 100-watt MAZDA C lamp directly behind the operator. These lamps have small hooks fastened to the socket which enable them to be hung from the roof of the car and as the lamps are behind the operator, glare does not result to any great degree. However, the danger lies in that the lamp of a neighboring operator may be objectionable. An angle reflector, on such a lamp, so fastened that it cannot swing about, will conserve light and reduce glaring interference.

The shops in general should have an even spacing of overhead units on centers such as 12 by 12, 15 by 15, etc. The hanging height in any case should range from between 10 and 18 feet. The greater height is preferable if it can be obtained. Fig. 10 shows a view of a typical Railroad Machine Shop.

A glance at this picture will convince one that the lighting of this shop is of the first order but even the most casual inspection will reveal one feature that is uncommon in railroad machine shop lighting. This is the entire absence of local lights. Machine operators are slowly being weaned away from the idea that local lights are

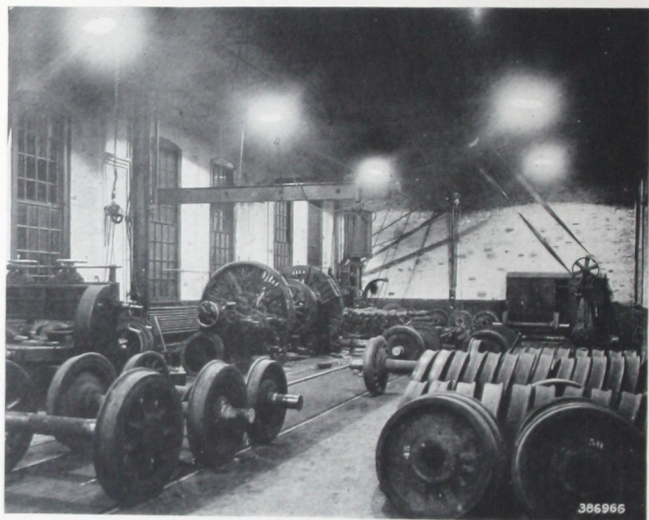


FIG. 11

A Wheel Shop Lighted by a General System of 400-Watt MAZDA C Lamps in RLM Dome Reflectors Spaced 17 by 15 Feet and Hung 17½ Feet High. The intensity is such that no drop cords are needed or used, 13 foot-candles being provided

indispensable to their work. There are several instances to be sure, where such a light must be used, but a great majority of the operations do not require one.

Under this general heading come two shops which usually are so sadly neglected that it was deemed advisable to accord them special attention. One is the Forge Shop and the other the Wheel Shop. The Wheel Shop shown in Fig. 11 possesses no unusual characteristics and is lighted by a simple overhead system employing type C

lamps in deep dome reflectors. The entire shop, however, is lighted almost as well by night as by day.

In Fig. 12 is shown a Forge Shop which differs radically from most such shops. Not only is the lighting very good, but the conditions which influence this to a great extent have also received consideration. The painting of the forges to make them reflect the maximum of light is a practice which is finding greater application each year, not in this class of shop but in others also, particularly machine shops.

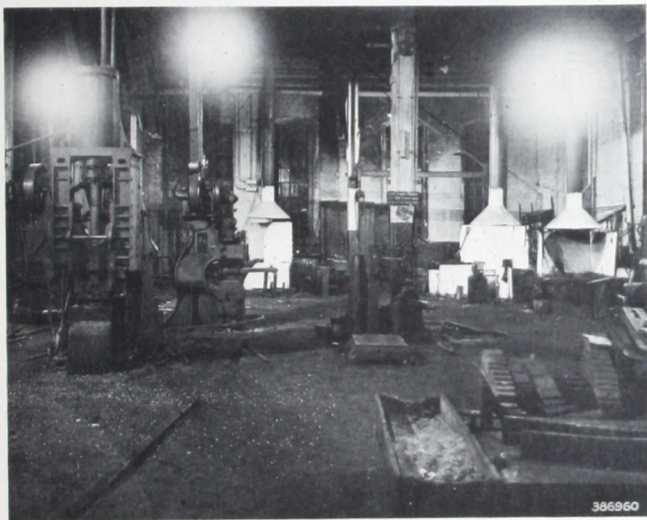


FIG. 12

An Up-to-date Forge Shop Lighted by 200-Watt MAZDA C Lamps in Shallow Dome Reflectors Spaced 20 by 30 Feet Apart and Hung 15 Feet High. Maintenance is carefully looked after as is attested by the painting of the forges in order to provide better reflecting surfaces

Outdoor Lighting

Yards and Scale Houses

As approximately 75 per cent of the revenue of railroads of the country is derived from the transportation of freight, it can easily be seen that anything tending to expedite the rapid handling of shipments of freight should receive careful consideration, in view of the large return afforded by it. Operation here is continuous and the lighting installation plays no small part in being one of the deciding factors in facilitating the rapid shipment of freight.

There are two main applications of light; these are the scale house and its immediate vicinity and the classification and receiving yards. Both require very careful consideration as the requirements are rather exact.

The tendency today is to use multiple lamps in both cases in order to avoid running high voltage lines around the yard. The principal requirements for scale lighting are shown diagrammatically in Fig. 13.

In the scale house, the beam and counterpoise must be clearly visible and at no point should glaring light sources or reflections be present; particularly so from the scale master's stand. The lighting installation of the scale house serves two primary purposes: First, to illuminate the cars as they approach, mount and leave the scale; and second, to light the beam and counterpoise of the scale, and the scale

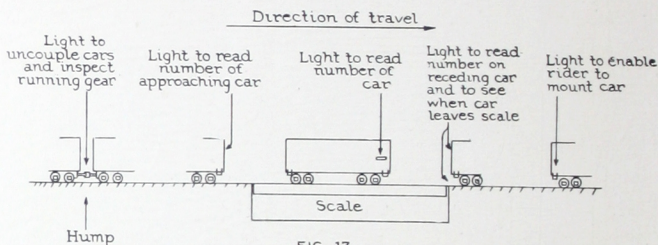


FIG. 13

REQUIREMENTS FOR PROPER SCALE LIGHTING

house itself. Where a slight error in weighing will interrupt the operation of the entire movement of the cars across the scale, it can be easily seen that the lighting installation must be of the first order. In Fig. 14 is shown a method of scale lighting which has worked out satisfactorily in practice and is to be recommended for average conditions. Where the scale house has no extensions to permit the hanging of units from the side of the house, a framework of iron piping could be erected at a small expense for supporting these units.

The hanging heights of the units shown in this figure were calculated for the conditions of the scale house location and scale length, as shown. Where these dimensions vary greatly from those assumed in this case, it may be necessary, when installing the units, to adjust them as to direction of throw and height, in order to obtain the desired intensity on the sides of the cars during the weighing operation.

For lighting the scale beam and counterpoise a method which has given good results makes use of three low wattage MAZDA lamps placed in deep bowl metal reflectors, so that the skirt of the reflector

entirely shields the lamp from the scale master's vision. These units, which are pendant, are hung seven feet above the floor and approximately 12 inches to the front of and in a line parallel with the beam. The distance between units is approximately half the length of the scale beam.

The lighting of the yard proper is a problem, the known quantities of which are always variable. No specific set of rules can be given for its lighting for even its growth is in many cases somewhat difficult to predict. In its infancy it may be a siding and as the demands increase is added to from time to time until a full fledged yard is the result.

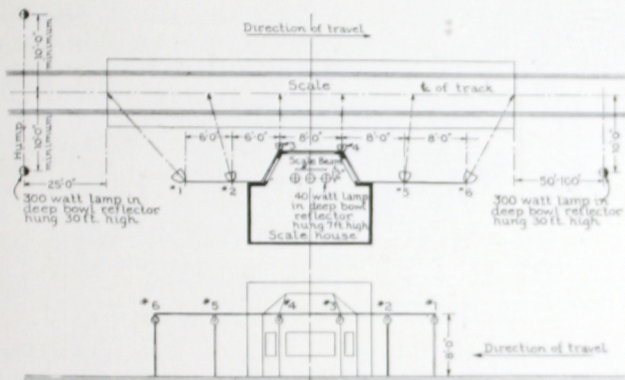


FIG. 14

SHOWING METHOD OF SCALE LIGHTING IN COMMON USE

*1 and *6 = 300 watt Mazda 'C' lamp in angle steel reflector —

*2 — *5 = 200

● = 300 watt Mazda 'C' lamp in deep bowl reflector

Practically every outdoor illuminant has been applied to the lighting of these yards. Some of the factors which have placed the incandescent lamp at the head of the list of available light sources are low maintenance requirements, easy replacement, comparatively fool-proof construction and simple operation, together with its high efficiency.

Two methods of applying the incandescent lamp for yard lighting have been developed; one of which makes use of refractor units, and the other floodlighting projectors. Each has its advantages and disadvantages, and each system has its adherents. One of the most serious objections to the use of floodlighting, when not properly

NOTE.—Broken sea shells, white gravel or whitewash should be placed on the ground around Hump units to diffuse light up beneath cars.

employed, is the ever present glare evil. Where these units are mounted high, however, and their direction of throw is with or across the tracks and not opposite to the movements in the yard, their use for lighting large yards is recommended. For small yards the refractor units are to be preferred. In Figs. 15 and 16 are shown two methods of yard lighting. The first makes use of 300-watt MAZDA C Multiple lamps in prismatic glass refractor units mounted not less than 30 feet high, in the case of narrow yards, and spaced approximately 200 feet apart. This system is particularly applicable to long narrow yards whose width does not exceed 200 feet.

Where the width of the yard is greater than this and there is no opening in the center of the yard to permit the placing of another line of similar units, floodlighting projectors should then be resorted to in

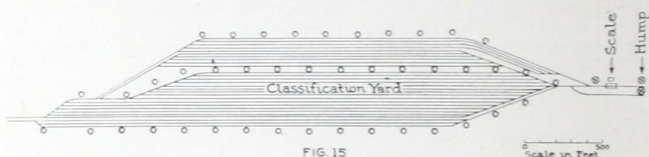


FIG. 15
PLAN SHOWING METHOD OF LIGHTING YARD WITH REFRACTOR UNITS.

- 300 watt Mazda 'C' multiple lamp in prismatic glass refractor.
- 300 watt Mazda 'C' multiple lamp in deep bowl reflector.

NOTE: Hanging height of deep bowl units, 30 feet.
Minimum mounting height of refractor units, 30 feet.

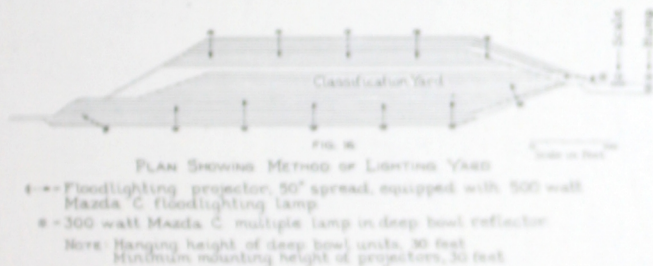
order to secure a desirable intensity. In Fig. 16 is shown a method of floodlighting employed for the same yard, the direction of throw of each floodlight being indicated by the arrows. It will be noticed that the units are staggered so that the individual cone of light from each floodlight fits into the neighboring ones, thus covering the entire yard. For this system 500-watt MAZDA C Floodlighting lamps are used in projectors with a spread of approximately 50 degrees. The units are spaced 300 feet apart and should be mounted not less than 30 feet high. High mounting is always preferable in order to reduce glare to a minimum and keep shadows short. The 500-watt unit is applicable in yards of from 200 to 400 feet in width. Above 400 feet the 1000-watt MAZDA C Multiple lamp should be employed in floodlighting projectors with suitable spacing and mounting height.

Fig. 17 gives data pertaining to these three types of installations. The results from either type are bound to be satisfactory if sufficient light is employed.

One of the most important factors controlling the success of yard lighting installations is the hanging height of units. The two most

exact requirements of yard lighting can be satisfactorily met if the proper hanging height is obtainable. The two requirements referred to are as follows:

Illumination of every track irrespective of position of adjacent cars, and illumination of every car in the yard. A chart which shows at a glance the relation between proper hanging height and width of yard is given in Fig. 18. At the bottom of this diagram is shown probably the worst condition to be met with in yard lighting—a coal car standing approximately in the center of the yard flanked on one side by a box car and on the other side, two tracks away, by another box car. By the simple projection of light rays (shown by dotted lines) to these cars from various heights at the side of the yard the correct hanging height at which these cars will all be illuminated can easily be determined.



Another bad condition is that of the area between box cars on adjacent tracks. No direct light from units strung along the sides of the yard can be expected to light this area. However, with a fairly high mounting height, depending upon the width of the yard, direct light striking the upper edge of the box cars will be reflected and some light will reach the ground.

At the top of the diagram are shown these conditions applied to yards of widths ranging from that of four track yards to twenty-four track yards. The equivalent width of yard is given in feet directly below this so that in cases where the symmetrical arrangement as shown is not in effect, the yard width can be used directly for determining the correct mounting height of the units. This diagram is directly applicable to yards up to and including a twenty-four track yard, but for yards exceeding this width, lines can be drawn parallel to the ones already shown, thus obtaining hanging heights for yards up to twenty-eight tracks in width. It is exceedingly doubtful

whether yards having greater widths than this will not have openings in them which will permit running another line of units, thus picking up the area not covered by the other units. Example: Suppose a fourteen track yard (180 feet in width) is to be illuminated; at half the width, seven tracks (or 90 feet), will be found a dotted line running to 38 feet; similarly for a twenty track yard, the height is seen to be 53 feet. These hanging heights will evidently meet the most extreme conditions and other less exacting requirements will be adequately provided for.

It will be noted from the diagram that narrow yards require hanging heights below 30 feet, but in order to avoid confusing enginemen and also to reduce glare to a minimum, hanging heights of units should, in no case, go below 30 feet.

300 WATT MULTIPLE LAMP IN PRISMATIC REFRACTOR UNIT		500 WATT FLOODLIGHT LAMP IN FLOOD LIGHTING PROJECTOR SPREAD OF BEAM 50°		1000 WATT MULTIPLE LAMP IN FLOOD LIGHTING PROJECTOR SPREAD OF BEAM 30°	
WIDTH OF YARD	SPACING	WIDTH OF YARD	SPACING	WIDTH OF YARD	SPACING
30-200 FT.	200 FT.	200 FT.	200 FT.	500 FT.	275 FT.
		250	230	600	330
		300	280	700	380
		350	330	800	430
		400	375	900	480
				1000	540

FIG. 17

INSTALLATION DATA COVERING REFRACTOR UNITS AND PROJECTOR UNITS

In cases where mounting heights as shown cannot be obtained, the height nearest to this should be resorted to, but at heights less than those specified, it is evident that some of the worst conditions will not be satisfactorily met. In any event, the roofs of all of the box cars must be illuminated, to permit riders coming down the yard to distinguish cars and couple them with minimum danger of breakage to either car or cargo. In order to facilitate this, it is suggested that a narrow strip be painted in white on each end of the box car, both on the roof and on the end side of the car. This simple practice will prevent a considerable amount of breakage.

In one case where special consideration was given to this problem and the lighting installation was designed to take this into account, a saving of fully 60 per cent was effected on breakage of rolling stock from bumping of cars, with attendant increased safety to workmen.

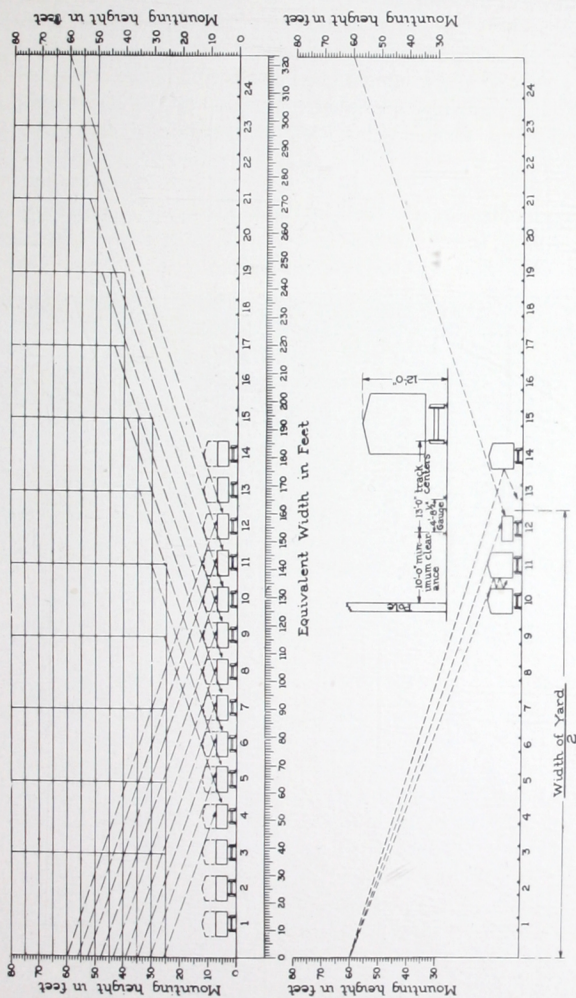


FIG. 18
 CHART SHOWING CORRECT HANGING HEIGHTS OF UNITS FOR
 PROPER YARD LIGHTING

Night pictures of yards showing the results obtainable with these two methods of lighting are shown in Figs. 19 and 20. In Fig. 19, the units are mounted very low, about 22 feet, in fact, and the resulting glare is naturally objectionable. As stated elsewhere, the hanging height should in no case be less than 30 feet.

That high hangings are practical is proven by Fig. 21 which shows a close-up of the poles used for supporting the units in Fig. 20.

Turntables

The work of turning the table and engine does not demand a great amount of light, merely enough for safe operation and to facilitate stopping the turntable at the proper point.



FIG. 19

Night View of Yard Lighted by 600-c.p., 6.6-20-amp. Series MAZDA C Lamps in Dome Refractors and Rippled Globes, Mounted 22 Feet High and Spaced Approximately 175 Feet Apart. While the intensity on local areas is fairly high, the hanging is so low that the units are on a level with the car riders eyes

One scheme of lighting the table and adjoining area, which is often employed but cannot have much said in its favor, employs 200-watt MAZDA C lamps in diffusing globes placed on the inner edge of the roundhouse roof, one unit to every three or four stalls. This method wastes the light, little reaching the turntable, the area between the table and the roundhouse receiving most of the light.

Another method makes use of floodlights mounted on the roof of the roundhouse, projecting light on the area involved. As these floodlights throw the light against the direction of traffic, however, a great deal of glare may be encountered.

The third and best scheme, especially applicable to half circle roundhouses, is to mount 500-watt MAZDA C lamps in deep bowl, porcelain-enamel-finish reflectors, on 35 or 40-foot poles. Two such units are recommended, one on each side of the turntable, approxi-

mately 35 feet away from and slightly to the rear of it. To eliminate the likelihood of the area between the roundhouse and the turntable being left in darkness by the blowing off of steam by locomotives while in the vicinity of the turntable, one floodlighting projector with a factory ribbed glass front cover to minimize glare should be mounted on the center of the roundhouse. For turntables above 60 feet, it is advisable to mount a 100-watt MAZDA C lamp in an RLM Dome reflector with weather-proof holder on an iron pipe standard approximately nine feet high on each end of the table.

In case of full circle roundhouses, poles cannot be conveniently placed without interfering with the track arrangement. The use of floodlights placed on the roundhouse must be resorted to in such



FIG. 20

Night View of Yard Lighted by 1000-Watt Multiple MAZDA C Lamps in Floodlighting Projectors, Mounted 65 Feet High and Spaced 500 Feet Apart. This exceptionally good installation indicates the trend toward large units and great mounting heights

cases, but they should be equipped with factory ribbed glass to throw the light in a broad band on the area immediately encircling the turntable.

Coaling Stations

This type of building consists primarily of a track shed in which loaded coal cars are run, the coal then being dumped into a pit beneath the car from which it is raised mechanically by a conveyer and carried over to the storage pockets adjoining the track shed. From these pockets the coal is loaded by means of chutes onto the tenders. Adjoining the opposite side of the track shed is a sand storage bin from which sand is conveyed to a pocket adjacent to the coal storage pockets for loading on the locomotives. Fig. 22 shows a

typical coaling station, together with the arrangement of the outlets. It will be noted that in all covered portions of the coaling station 100-watt MAZDA C lamps in RLM Dome reflectors are recommended, while for the outdoor or uncovered parts 200-watt MAZDA C lamps in RLM Standard Dome reflectors are called for. Plug outlets are provided for the insertion of trouble lamps at frequent intervals where construction of the station is such as to render local lights necessary at those points.



FIG. 21

Day Picture of Yard in Fig. 20 Showing Construction of Poles

Stations

Terminals

At the end of all Divisions are found structures commonly referred to as passenger terminals. These may vary in size and construction from simple, unpretentious buildings to magnificent structures of granite and marble, occupying an entire city square, making a veritable city in themselves. Aside from the ornateness of these buildings there is also attached a certain advertising value, as a structure of this kind becomes known and talked of over the entire country. Since it is in use practically all hours of the day, it is no small part that the lighting plays in the impressions created on the traveling public. Not only must light in abundance be provided but the installation as a whole must be in harmony with the architecture.

The principal requirement for lighting, outside of the spectacular element, is that of furnishing adequate illumination throughout the entire waiting room to see to read for short periods of time with ease and to experience the general comfort of being in a well lighted interior. There are points, such as the ticket windows, bulletin boards, and entrance to train platforms, where efficiency of operation demands a high intensity of illumination. To make change and sell tickets speedily and with accuracy and to examine tickets rapidly make it desirable to have local lighting at these points.

The form taken by the general lighting system can indeed be varied. Direct lighting from central chandeliers or massive fixtures

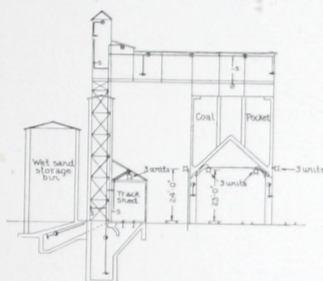


FIG. 22

SECTION OF COALING STATION SHOWING LOCATION OF OUTLETS

- 50 watt Mazda B lamp, all frosted
- 100 watt bowl enameled Mazda C lamp in RLM standard dome reflector
- 200 watt clear Mazda C lamp in RLM standard dome reflector
- ⌞- Plug outlet

enclosing units of suitable size, semi-indirect, totally indirect, cornice lighting and other systems have all been employed with differing degrees of success. It is quite outside of the province of this bulletin to attempt to lay down any broad rules. In view of the massiveness of the structure and ornateness of design, each problem should be given individual attention. It is well to bear in mind that the light colored surroundings usually employed act as reflecting and diffusing media, and, unless care be taken in the design, a flat appearance or distortion of perspective may result.

On the other hand, the light surroundings make the utilization fairly high and tend to provide adequate intensities with a minimum wattage.

Unshielded lamps in the field of view should, of course, be avoided and care should be taken to eliminate glaring reflections from polished marble or similar objects.

The local lighting provided at the points mentioned should be of such a character that the lamps are not visible, and where possible the type of fixture employed should harmonize with the main or overhead units.

The concourse should also be in keeping with the main waiting room, while special lighting should be provided in the stores and offices as discussed in Bulletins Index 34 and 35, "Lighting of Distinctive Shops" and "Lighting of Office Buildings" respectively.



FIG. 23

Day View of a Large Terminal with Installation of Two Main Chandeliers Studded with 50-Watt White MAZDA Lamps and Smaller Similar Units Employing the Same Type of Lamps Used as Wall Brackets. Due to the monumental nature of the building the decorative element is given precedence

Train Sheds

Besides furnishing means of ingress to and egress from coaches, train platforms are also used for trucking purposes, which necessitates using a higher intensity than that required for safe walking conditions along passageways. Particular attention must be paid to the location and equipment on the stairways. Many a claim is made against a railroad for a fall which is directly due to temporary blinding from a glaring light source. Exposed lamps in such places are a true form of

negligence. All pieces of baggage have checks attached to them on each of which is marked such information as destination of baggage, sender, weight, contents, etc. Many of these checks are colored and the intensity should be high enough to afford easy reading of them. The distribution of light should be fairly even over the entire length of the platform, inasmuch as the position of trains with regard to the platform is not fixed. Sufficient light should be thrown on the steps of the cars, particularly the outer edges, to prevent stumbling or mis-

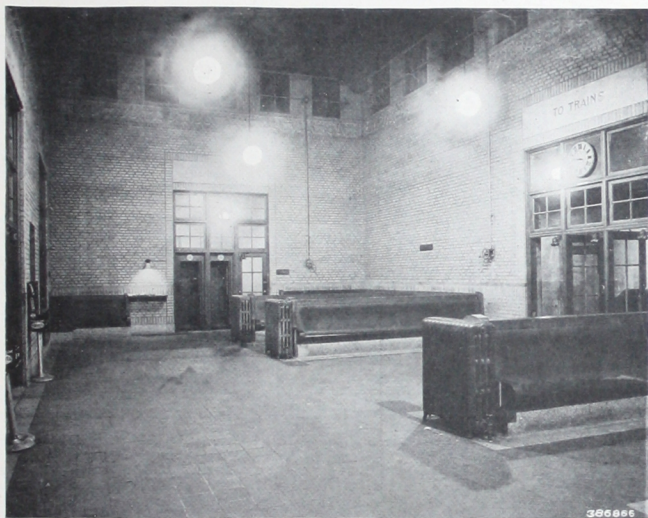


FIG. 24

Night View of a Way Station Lighted by Four 300-Watt MAZDA C Lamps in Prismatic Glass Enclosing Globes Placed at the Corner of a Diamond Shaped Rectangle Measuring 17 Feet on a Side. Units are hung about 20 feet high

stepping. Approximately $\frac{1}{4}$ of a watt per square foot of platform surface is sufficient and may best be utilized by 200-watt clear MAZDA C lamps in deep bowl porcelain-enamel-finish reflectors, spaced 30 feet apart on the center line of the platform and hung twenty feet high. This would provide ample illumination for all ordinary purposes, allowing for a reasonable depreciation due to coatings of dust on lamp and reflector surface, resulting from smoky conditions where steam locomotives come into the terminal.

Way Stations

These may vary in size from small, one story structures of country towns to buildings approaching in size that of a small terminal. They can be effectively lighted by semi-enclosing or enclosing diffusing units, uniformly spaced with as high hanging as possible, and about two foot-candles should be provided throughout the room with local lighting at the ticket windows.

There are two general types of way station platforms, one is commonly known as the umbrella type which consists primarily of an inverted "V" shape roof, supported by a line of columns on the center line of the roof. As the supporting columns are spaced approximately 15 feet apart and the platform is about 15 feet wide, a single row of 100-watt bowl enameled MAZDA C lamps in RLM Dome reflectors, spaced 30 feet apart and mounted not less than ten feet high will provide good lighting for the platform such as to enable passengers to mount coaches in safety and to facilitate general trucking of baggage around the platform.

The second type of platform is one that has no roof and bracket units are recommended, employing 75 or 100-watt MAZDA C Bowl enameled lamps in shallow dome reflectors spaced approximately 25 feet apart.

Loading Platforms

Inadequate illumination is often the primary cause of missent shipments of goods, resulting in tie-ups and loss of money other than that due to the particular piece missent. Good lighting for this purpose requires between $\frac{1}{4}$ and $\frac{1}{2}$ of a watt per square foot of floor area. This lighting should be provided by efficient lamps placed in suitable reflectors of durable construction which can be easily maintained.

As goods are often piled nearly to the ceiling a strictly general system of illumination is in many cases impracticable, but the aisles and passageways should be lighted to a fairly high intensity for reading labels, checking destination, trucking, etc. The lighting of the passageways can easily be accomplished by 75, 100 or 150-watt MAZDA C lamps in RLM Standard Dome reflectors. With a low ceiling height of 10 feet or less, the spacing should be approximately 15 feet and 75-watt lamps should be used. The 100-watt MAZDA C lamp is satisfactory where the spacing is approximately 20 feet and the hanging height from 10 to 15 feet. The 150-watt MAZDA C lamp can be used where the ceiling height exceeds 15 feet and the spacing is approximately 30 feet.

Loading platform lighting makes no special demands other than providing light enough to facilitate easy moving of freight to box cars on adjacent sidings and meeting ordinary safety requirements. Here again, in the case of roofed-over structures, the ceiling height plays an important part in determining the size of lamp and spacing. For low spacings, ten feet or under, the size of lamp should not exceed 100 watts and the spacing should be limited to 15 feet. For a ceiling height approaching 15 feet excellent results can be obtained by using either 200 or 300-watt MAZDA C lamps in opalescent diffusing globes, hung close to the ceiling and spaced 30 and 40 feet apart respectively. Fig. 25 shows a night view of such an installation.



FIG. 25

Night View of a Loading Platform 220 Feet Long, Lighted by Five 300-Watt MAZDA C Lamps. These lamps are enclosed in opalescent diffusing globes and are suspended close to the 16-foot ceiling. The intensity of illumination is high and the light colored surroundings reflect the light and cause it to be quite evenly distributed.

The lighting of the interiors of the box cars can be accomplished by means of extension cords and 50-watt MAZDA B lamps. These extension lamps can be provided with a hook to permit their hanging from the roof and can be run from socket receptacles placed along the track edge of the platform, a trifle below the level of the car door.

Special Considerations

Repair Pits

For lighting repair pits, 40 or 50-watt bare MAZDA B lamps can be used in sockets placed in niches in the walls for general lighting. Local lighting can be taken care of by means of lamps on extension cords run from sidewall receptacles. In order to cut down glare as much as possible, it is advisable that these lamps be all frosted.

Oil Torches vs. Portable Lamps

The practice of using hand oil torches in engine houses and erecting shops when working on the interior of locomotive boilers, where the light from overhead units cannot penetrate, is adhered to by quite a number of companies. The thought suggests itself that railroad lines thoroughly up-to-date and modern in every respect as to rolling stock, shops and equipment, would find more suitable means for supplying proper lighting equipment for use where the ordinary lighting installation is ineffective. On the surface of it, however, the problem is not quite so simple. The most effective and economical rival of the hand oil torch is the portable incandescent lamp, but most operators prefer using the oil hand lamps and so avoiding the necessity of dragging many feet of extension cord behind them wherever they may chance to move, with the likelihood of this cord becoming tangled around obstructions, being caught in crevices, or run over by trucks or engines and thus being destroyed.

The oil hand lamp at best is but a makeshift. Its light is comparatively feeble and the open flame introduces a personal fire hazard, which, together with the smoking of the lamp, do not leave much to its advantage other than its portableness and ease of handling.

If a little thought were given to the portable incandescent lamp unit application to such uses as described, it would find more favor. One great drawback to its general use is that the cord becomes broken or otherwise damaged which results in considerable delay and annoyance. Obviously, if this fault is corrected, its biggest disadvantage is eliminated. It is suggested that some form of armored cable or protecting carrier be used on the cord to enable it to withstand handling and rough usage. The lamp itself should be provided with a metallic guard for protection and a metal hook to permit its being hung from pipes, projections, etc. The increase in light provided by an incandescent lamp extension unit over that from an oil hand torch is enough to warrant its extra trouble in handling, and after operators become accustomed to using such a unit the oil hand lamp will seem but a poor substitute at best.

Electric Hand Lanterns

The use of oil hand lanterns for yard service is attended by a certain amount of fire risk in movements involving the make-up of trains containing loaded oil cars. The element of safety here is of such importance and loss from a possible fire so great that it is well to take extra precautions when handling these cars.

The use of electric hand lanterns for such cases, where the fire risk is so great, is coming more into vogue and in some instances special lanterns have been designed to meet this need. Such a unit is shown in Fig. 26.



FIG. 26

An Electric Safety Hand Lantern for Yard Service

Maintenance

Railroad companies have extensive departments known as Maintenance of Ways Departments. These are for the purpose of keeping the roadbed, bridges, rolling stock, etc., thoroughly up-to-date. Many times, however, this fundamental principle of efficient operation is not extended to unobtrusive, but no less important, parts of shop equipment. A lighting installation can perform satisfactorily only if it receives a reasonable degree of maintenance in the form of reflector and lamp cleaning, refilling empty sockets, replacing lamps whose useful life has been exceeded, etc. See Bulletin Index 14, "The Maintenance of the Lighting System." While a faulty lighting installation may not constitute a direct hazard to the lives of workmen, yet it is an indirect contributing cause to many accidents which could otherwise have been prevented had proper lighting been used. It is only under an efficient, well maintained lighting installation that work can be conducted properly.

The Foot-Candle Meter

A small self-contained instrument to read quickly the illumination intensity is shown in Fig. 27. Little or practically no experience is required for its operation.



$\frac{1}{4}$ Size

FIG. 27

The Foot-Candle Meter

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